Coastal Plain Pond Complexes

Target Description

Also known as Delmarva Bays, or whale wallows, coastal plain ponds represent an unusual and unique type of shallow, irregularly inundated, freshwater depressional wetland occurring on the coastal plains of the East Coast. Pond hydrology is driven by precipitation and groundwater in the area. Winter water table mounds adjacent to ponds recharge them through short shallow groundwater flow paths. These unique wetlands occur up and down the North Atlantic Coast, but the Corridor study area has one of the highest densities of them on Delmarva, with more than 53 complexes identified and over 675 individual ponds (not including ponds in Maryland). (Map T.)

In the Corridor, some ponds are in an entirely forested context, while others are in an entirely open context, sometimes in the middle of an agricultural field in which case it is not unusual for ponds to be cultivated in drier years or after years of cultivation has silted them in. Of course, numerous coastal plain ponds were drained by tile fields so that they could be farmed.

Water levels that rise and fall over the course of the year in connection with the water table give coastal plain pond complexes unique hydroperiods. Because they are sometimes flooded and sometimes dry, they support a unique combination of plants that are adapted to cope with the change in water levels. A good example is featherfoil, which is state rare (S2) and in Delaware only thrives in coastal plain ponds in the Corridor. An exotic looking plant, Featherfoil is entirely dependent on the fluctuating water levels of seasonal ponds to complete its life cycle. As an annual species, it must reproduce by its seed, which germinate in late summer or early fall when the ponds are typically dry. After germination, a small rosette of leaves develop, which over winters even in standing water. In early spring when the ponds are flooded, a stem develops from the winter rosette and begins to elongate through standing water to reach the surface. Once at the surface, flower stems develop that are hollow which allows the plant to float at the surface. The plant flowers and sets seed while the ponds are still flooded (all in a short window of time). The seeds mature on the plant, fall, then sink through the water column and rest on the pond bottom. When the ponds draw down, the seeds germinate and the cycle repeats. This is just one example of the unusual plants that depend on Corridor Coastal Plain Ponds.[1] Some other unusual coastal plain pond plant species spotted in the Corridor include tea love-grass, harper's dwarf fimbry and false hop sedge.

Because fish cannot survive the dry spells, coastal plain ponds are a safer habitat for frog and salamander eggs and larvae. They support an incredible diversity of amphibians, including five salamander species and 13 frog species. One of rarest of these species in the Corridor is the tiger salamander -- a species of conservation concern that is black with large yellow blotches and is

[1] Email communication with Bill McAvoy of the Delaware Natural Heritage Program, January 2005.

dependent on the coastal plain ponds and associated forests of the Corridor. It lays its eggs in the ponds when they first thaw in late winter or early spring, where the eggs mature, hatch and form larvae. The larvae remain in the pond until summer when they emerge to live in the surrounding forest. Some other interesting amphibians that rely on Corridor coastal plain ponds include the four-toed salamander, the barking tree frog, and the rough green snake -- which is striking with its slender bright green appearance, but blends in with its surroundings quite well as it forages among shrubs and vines along streams and wetlands.[2]

In addition to these rare plants and animals, Coastal Plain Ponds have also been known to host unusual dragonflies and birds.

Indicators of Healthy Coastal Plain Pond Complexes

The four key attributes selected as those most important to sustained coastal plain pond complex health are connectivity between ponds (as indicated by pond density within complexes), natural hydroperiod (as indicated by depth and duration of inundation), healthy biological composition and structure (as indicated by forested buffers), and connectivity between ponds and upland forest habitats (as indicated by forested corridors between ponds). The analysis surrounding each of these attributes and their indicators is presented below.

Where are the Maryland Ponds?

Coastal plain ponds are included (and mapped) in the National Wetland Inventory (NWI), but not distinguished from other types of wetlands. Several years ago, The Nature Conservancy (Mark Zankel) and the Delaware Natural Heritage Program (Pete Bowman) worked together to develop a data set for coastal plain ponds in Delaware based on NWI data, but fine-tuned using a set of parameters and/or ground truthing. Unfortunately, a data set of this accuracy has yet to be developed for Maryland's coastal plain ponds. So, Maryland ponds are shown on maps (using a slightly improved version of NWI data provided by USFWS Rick McCorkle) but were not included in any of the viability analysis described here. Improving coastal plan pond data for Maryland is a research need

Pond Density: An Indicator of Coastal Plain Pond Community Connectivity

Coastal plain ponds occur in complexes, or groupings, connected by a shallow groundwater source. In order to maintain viable populations of amphibians, there must be other ponds within migrating distance for genetic exchange. Since this connectivity (or near connectivity) is critical for amphibian breeding, it was selected by Corridor scientists as a key ecological attribute for coastal plain ponds. Research suggests pond density as a good indicator for the connectivity needed for breeding amphibians, and that pond densities of .48-.59 wetlands per square kilometer (.002-.0024 per acre) are adequate for successful breeding.[3] These densities actually seem rather low for the Corridor, where tracts known to support healthy salamander populations have a density of 30-100 ponds per 500 acres, indicating that a more thorough analysis of coastal plain pond densities and their relationship to breeding may be required. In the meantime, Corridor scientists developed the thresholds in Figure 19 based on the Semlitsch findings, which although not from this region, represent the best current information on densities.

[2] Email communication with Keven Kalasz of the Delaware Natural Heritage Program, January 2005.

[3] Semlitsch, R. D. 2002. Critical elements for biologically based recovery plans of aquatic-breeding amphibians. *Conservation Biology*; 16 (3).

To rate the condition of coastal plain ponds in the Corridor, The TNC GIS intern began with the coastal plain ponds GIS layer (Maryland only – see sidebar) and applied a 250 meter buffer on all ponds to identify complexes of ponds. Any buffers of ponds that didn't intersect were left out or divided into separate complexes. Complexes were then divided by drainage, roads, and development. They were further edited to insure that all ponds within a complex were within 1000 meters of each other. Ponds in agricultural areas were not included unless the particular pond was close to a forest pond.

Figure 19
Pond Density Indicator Ratings:
Poor: complexes with < .0024 ponds per acre
Fair: complexes with .0024-.04 ponds per acre
Good: complexes with .04-.08 ponds per acre
Very Good: complexes with .08-1 ponds per acre

Once the complexes were determined, the total number of ponds in each complex was counted and the total number of ponds was divided by acreage. Results, based on the thresholds in Figure 19 are: 22% of complexes rate "Very Good", 57% rate "Good", 19.5% rate "Fair", and only 1.5% rate "Poor" These results are shown geographically in Map T.

Although no corridor-wide parameters were established for this measure, results indicate that nearly all Corridor complexes (98.5%) have greater than the .0024 ponds per acre suggested by research, which indicates "Very Good" status.

Depth and Duration of Inundation: An Indicator for Hydroperiod

Hydroperiod was also selected by Corridor scientists as a key attribute of coastal plain ponds, because it is known to be a key factor for survival of amphibians, especially salamanders. The relevant indicator for measuring hydroperiod is the depth and duration of inundation of ponds. Inundation from December through late July -- during spring breeding -- is most favorable for amphibians and was the basis for the thresholds developed and shown in Figure 20).

Since there is no substantial data tracking coastal plain pond inundation in the Corridor at this time, measuring this indicator remains a future research need. However, as of December 2004 the DNREC Natural Heritage Program is developing a proposal for gathering additional coastal plain pond data, including the analysis of data collected for a very small sample in the Corridor by USGS over time. Also, Dr. Visalis at the University of Delaware is in engaged in research that may shed some light on this indicator for the Corridor over time as well.

Figure 20
Depth and Duration of Inundation Indicator Ratings:
Poor: average of <1 pond per complex inundated throughout entire breeding season, December to late July, on average
Fair: Average of 1 pond per complex with inundation from December to late July, on average
Good: average of 2-3 ponds per complex with inundation from December to late July, on average
Very Good: average of 3-4 ponds per complex with inundation from December to late July, on average

Forested Habitat Surrounding Ponds: An Indicator of Biological Composition and Structure

According to science team members, another key factor for amphibian survival is the presence of upland forested habitat nearby: Adult salamanders spend 90-95% of their time in upland habitats surrounding

aquatic breeding habitats. In a 2002 study (not within this region), adult salamanders of six species[4] were found an average of 125.3 meters from the edge of aquatic habitats, and some were found up to 625 meters from aquatic habitats.[5] A buffer zone encompassing the majority of the population would have to encompass the terrestrial habitat 164.3 meters (534 feet) from a wetland's edge. It is important to note that some of the literature values used in this analysis were minimum estimates of mean distances traveled from ponds because of limited monitoring time or due to increased search area as the radius from the pond increased. The measured values therefore probably underestimate the actual buffer zone needed to encompass 95% of the population of some species of salamanders. However, Corridor scientists used average distance to develop the thresholds shown in Figure 21.

To calculate the extent of forested buffers for Corridor coastal plain pond complexes, the TNC GIS intern applied 165-meter and 250-meter buffers around each pond, along with forest cover data, then calculated the number of ponds in each complex with 100% forested buffers. Based on this analysis, 80% of complexes rated as "Poor", 18% rated "Fair", and 2% rated "Good" (none rated "Very Good")

Although no corridor-wide parameters were established for this measure, results indicate that 12% of ponds have a buffer of 250 meters or more and 24% have 165 meters or more. This suggests a rating of "Poor" (but very close to being "Fair".)

Figure 21
Forests Surrounding Ponds Indicator Ratings:
Poor: <25% of coastal plain ponds within complexes have 165 m forested upland
Fair: 25-50% of coastal plain ponds within complexes have a 250 m forested upland or >50% with 165 m forest upland
Good: 50-75% of coastal plain ponds within complexes have a 250m forested upland
Very Good: 100 % of coastal plain ponds within complexes have a 250 m forested upland

It should be noted that, while forested context is extremely important, forest succession can also be problematic and completely forested/enclosed ponds do not necessarily support the most or best diversity of species.[6] This could have important implications for management recommendations (and whether or not 100% forested within the buffer is ideal) but additional research and data is needed to determine a more exact ideal forested context.

Forested Corridors Between Ponds: An Indicator of Connectivity

In recognition that travel between ponds is needed to maintain healthy metapopulations of anurans and salamanders, Corridor scientists selected another type of connectivity -- for animal travel habitat continuity -- as a key coastal plain pond attribute. The existence or extent of forested corridors between ponds was identified as an appropriate indicator for measuring this type of connectivity, and the thresholds in Figure 22 were developed. However, subsequent information indicated that amphibians do not necessarily move between ponds, but from upland areas to ponds making this indicator less meaningful than originally thought. Since there is more diversity in the coastal plain ponds within the Cypress Branch watershed than in the Blackbird Creek watershed, a long-term goal might be to attempt

[4] Appendix XII includes the names of these salamanders.
[5] Semlitsch 2002
[6] Personal communication with Jim White (Amphibians of Delmarva) and William McAvoy (Delaware Natural Heritage Program).

to influence an eastward migration through the Corridor by protecting a "path of least resistance" across the Corridor. [7]

Figure 22
Forested Corridors Between Ponds Indicator Ratings:
Poor: <60m wide forested corridor between ponds
Fair: 60-100m wide forested corridor between ponds
Good: 100 m - 150m wide forested corridor between ponds
Very Good: >150 m wide forested corridor between ponds

A separate analysis was not pursued for this measure, since it is likely that this aspect is already captured (at least in part) through the forest buffer analysis, and patch isolation analysis for forests. Based on the "forested habitat surrounding pond" indicator ratings, at least 25% of complexes have >150m wide corridors between all ponds (because they are completely forested within 165m) and likely a great deal more have a lesser-width corridor. This provides some insight into the status of forested connectivity between ponds in the Corridor. While this measure was not employed for Corridor analysis, it is worth noting that the potential importance of forested corridors between ponds was considered.

Water pH Regime: An Indicator of Water Quality

PH Regime was also selected by Corridor scientists as a key attribute of coastal plain ponds, because of the sensitivity of amphibians and plants to water and soil acidity. The thresholds shown in Figure 23 were developed based on those pH tolerances.

Figure 23
Water pH Indicator Ratings:
Poor: pH <4.5 or >6.5
Fair: pH 4.5-5
Good: pH 5 - 5.5
Very Good: pH 5.5-6

Since there is no substantial data tracking coastal plain pond pH in the Corridor at this time, we are currently unable to measure this indicator and it remains a future research need. However, as of December 2004 the DNREC Natural Heritage Program is developing a proposal for gathering additional coastal plain pond data, including the analysis of data collected for a very small sample in the Corridor by USGS over time.

Threats to Healthy Coastal Plain Pond Complexes

The primary stresses to Coastal Plain Pond complexes are alterations to natural hydroperiod and pH regime, changes in biological composition and structure and the loss of habitat and connectivity (the latter three due mainly to clearing of forests.)

There were five primary sources of stress found to impact key coastal plain pond attributes. These sources, and the results of analysis evaluating them, are presented in Figure 24 below.

[7] Personal communication with Jim White (*Amphibians of Delmarva*)

Figure 24

Threats - Sources of Stress			Hydroperiod	Biological composition and structure	Water pH Regime	Animal Travel Habitat Continuity	Habitat Loss	Threat to System Rank
Coastal Plain Pond Complexes			*Medium*	*Medium*	-	*Medium*	*Medium*	
1	Construction of ditches, dikes, drainage or diversion systems	Contribution	Very High	Very High		Low	Medium	Medium
		Irreversibility	Low	Low		Low	Low	
		Override						
		Source	High	High	-	Low	Low	
		Combined Rank	Medium	Medium	-	Low	Low	
2	Loss of natural upland buffer to residential development	Contribution	Medium		Low	Medium	Low	Medium
		Irreversibility	High		High	Very High	Very High	
		Override						
		Source	Medium	-	Medium	High	Medium	
		Combined Rank	Low	-	-	Medium	Low	
3	Invasive/alien species	Contribution	Low	Low			Medium	Low
		Irreversibility	Low	Low			Low	
		Override						
		Source	Low	Low	-	-	Low	
		Combined Rank	Low	Low	-	-	Low	
4	Loss of natural upland buffer to agriculture	Contribution	Medium		High	High	High	Low
		Irreversibility	Low		Low	Low	Low	
		Override						
		Source	Low	-	Medium	Medium	Medium	
		Combined Rank	Low	-	-	Low	Low	
5	Unsustainable/incompatible forestry practices	Contribution		Medium		Low	Low	Low
		Irreversibility		Low		Low	Low	
		Override						
		Source	-	Low	-	Low	Low	
		Combined Rank	-	Low	-	Low	Low	

There were no "high"-ranking threats identified to coastal plain pond communities. However, the "medium" sources of stress are the construction of ditches, dikes, drainage, or diversion systems and the loss of natural upland buffer to residential development. The loss of natural buffer to development directly adjacent to ponds results in elimination of forested habitat around ponds and isolation of amphibian populations, and is likely to increase over time as development pressure increases. With agricultural use in the region shrinking, draining or ditching of ponds for agricultural purposes is not likely to increase dramatically as a source of stress. However the impact to coastal plain pond clearing/draining from the elimination of federal protection for isolated wetlands is yet unknown and deserves monitoring. (See sidebar regarding SWANCC issue below.)[8]

[8] *The SWANCC Decision: Implications for Wetlands and Waterfowl: Executive Summary. 2001. Retrieved December 13, 2004 from http://www.ducks.org/conservation/404_report.asp.*

Lesser sources of stress to coastal plain pond systems include invasive/alien species (*Phragmites* and agricultural weeds), loss of natural upland buffer to agriculture, unsustainable and unsustainable or incompatible forestry practices – which includes both clear cut (within 650 meters) and selective logging (within 300 meters) of coastal plain ponds.

SWANCC: A Threat to Corridor Coastal Plain Ponds?
In 2001, a Supreme Court case --commonly referred to as the SWANCC case -- was decided that effectively removed coastal plain ponds from federal Clean Water Act protection. However, the majority of the coastal plain ponds in our region occur on agricultural land, where farmers will lose their Farm Bill subsidies if they destroy coastal plain ponds to plant crops (a provision called Swampbuster.) During the planning process for the Corridor, the creation of state wetland legislation to counteract SWANCC was discussed as strategy to reduce threats to coastal plain ponds (and their forested contexts.) However, the unpopularity of such legislation (based on past attempts and a strong local voice against regulation) led to favoring other non-regulatory approaches for protecting coastal plain ponds, while continuing to monitor the effects of SWANCC locally.